



## UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

## NOTICE OF ALLOWANCE AND FEE(S) DUE

21186 7590 03/17/2008

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.  
P.O. BOX 2938  
MINNEAPOLIS, MN 55402

EXAMINER

PHU, PHUONG M.

ART UNIT

PAPER NUMBER

2611

DATE MAILED: 03/17/2008

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/750,587	12/29/2003	John S. Sadowsky	884-A56US1	8576

TITLE OF INVENTION: SYSTEMS AND METHODS FOR ADAPTIVE BIT LOADING IN A MULTIPLE ANTENNA ORTHOGONAL FREQUENCY  
DIVISION MULTIPLEXED COMMUNICATION SYSTEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1440	\$300	\$0	\$1740	06/17/2008

**THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED.** THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

**THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED.** SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

## HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

**IMPORTANT REMINDER:** Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

# **PART B - FEE(S) TRANSMITTAL**

**Complete and send this form, together with applicable fee(s), to:** **Mail** **Mail Stop ISSUE FEE**  
**Commissioner for Patents**  
**P.O. Box 1450**  
**Alexandria, Virginia 22313-1450**  
**or Fax** **(571)-273-2885**

**INSTRUCTIONS:** This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

21186 7590 03/17/2008

**SCHWEGMAN, LUNDBERG & WOESSNER, P.A.**  
**P.O. BOX 2938**  
**MINNEAPOLIS, MN 55402**

## **Certificate of Mailing or Transmission**

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE; address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10750.587 12/29/2003

John S. Sadovsky

884.A56U.S1

8576

**TITLE OF INVENTION: SYSTEMS AND METHODS FOR ADAPTIVE BIT LOADING IN A MULTIPLE ANTENNA ORTHOGONAL FREQUENCY DIVISION MULTIPLEXED COMMUNICATION SYSTEM**

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1440	\$300	\$0	\$1740	06/17/2008

EXAMINER	ART UNIT	CLASS-SUBCLASS
PHU, PHUONG M	2611	375-260000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a **Customer Number is required.**

2. For printing on the patent front page, list

- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, 1 \_\_\_\_\_
- (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 \_\_\_\_\_
- 3 \_\_\_\_\_

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies \_\_\_\_\_

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number \_\_\_\_\_ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature \_\_\_\_\_

Date \_\_\_\_\_

Typed or printed name \_\_\_\_\_

Registration No. \_\_\_\_\_

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
[www.uspto.gov](http://www.uspto.gov)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/750,587	12/29/2003	John S. Sadowsky	884.A56US1	8576

21186 7590 03/17/2008

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.  
P.O. BOX 2938  
MINNEAPOLIS, MN 55402

EXAMINER

PHU, PHUONG M

ART UNIT

PAPER NUMBER

2611

DATE MAILED: 03/17/2008

## Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 994 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 994 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

# Notice of Allowability

## Application No.

10/750,587

## Examiner

Phuong Phu

## Applicant(s)

SADOWSKY ET AL.

## Art Unit

2611

### - The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the Amendment filed on 2/8/08.
2. ☒ The allowed claim(s) is/are 1-17 and 19-30.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some\* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

## Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08),  
Paper No./Mail Date \_\_\_\_
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413),  
Paper No./Mail Date \_\_\_\_
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other \_\_\_\_.

### **DETAILED ACTION**

1. This Office Action is responsive to the Amendment filed on 2/8/08. Accordingly, claims 1-17 and 19-30 are currently pending; and claim 18 is canceled.

### **REASONS FOR ALLOWANCE**

2. Claims 1-17 and 19-30 are allowed.
3. References 20040165558, 20060018411, 6473467 and 20040165676 are additionally cited because they are pertinent to the claimed invention.
4. The following is an examiner's statement of reasons for allowance:

-Regarding independent claim 1, none of prior art of record teaches or suggests a transmitter comprising: a parser to parse a block of bits representing an orthogonal frequency division multiplexed symbol into groups of a variable number of coded bits; and subcarrier modulators to individually modulate the groups on orthogonal frequency division multiplexed subcarriers in accordance with spatial-frequency subcarrier modulation assignments to generate symbol-modulated subcarriers for subsequent RF transmission over a plurality of spatial channels, wherein the spatial-frequency subcarrier modulation assignments are provided by a receiving station to the transmitter to transmit the orthogonal frequency division multiplexed symbol, and wherein the receiving station comprises a subcarrier modulation assignment generator to determine the spatial-frequency subcarrier modulation assignments based on channel characteristics of the spatial channels prior to transmission to the transmitter.

-Regarding independent claim 13, none of prior art of record teaches or suggests a transmitter comprising: a parser to parse a block of bits representing an orthogonal frequency division multiplexed symbol into groups of a variable number of coded bits; and subcarrier

modulators to individually modulate the groups on orthogonal frequency division multiplexed subcarriers in accordance with spatial-frequency subcarrier modulation assignments to generate symbol-modulated subcarriers for subsequent RF transmission over a plurality of spatial channels, wherein the variable number of coded bits of each group is based on a subcarrier modulation assignment for a corresponding one of the orthogonal frequency division multiplexed subcarriers and a corresponding one of the spatial channels, wherein a wideband channel comprises up to four subchannels, each comprising a plurality of the spatial channels, wherein the subchannels have bandwidths of approximately 20 MHz, wherein each subcarrier of a subchannel is assigned an individual spatial-frequency subcarrier modulation assignment comprising between zero and ten bits per symbol, and wherein each subcarrier is to be modulated in accordance with one of the spatial-frequency subcarrier modulation assignment associated with a corresponding one of the spatial channels, and wherein the transmitter transmits the orthogonal frequency division multiplexed symbol over the spatial channels of each subchannel of the wideband channel.

-Regarding independent claim 14, none of prior art of record teaches or suggests a receiver comprising: subcarrier demodulators to demodulate the frequency domain representations for each subcarrier in accordance with spatial-frequency subcarrier modulation assignments to generate groups of bits; and a deparser to combine the groups of bits to generate a block of coded bits representing the symbol wherein the symbol is an orthogonal frequency division multiplexed symbol, wherein the spatial-frequency subcarrier modulation assignments are provided to a transmitting station to transmit the symbol, and wherein the receiver further comprises a subcarrier modulation assignment generator to determine the spatial-frequency

subcarrier modulation assignments based on channel characteristics of the spatial channels prior to transmission to the transmitting station.

-Regarding independent claim 17, none of prior art of record teaches or suggests a receiver comprising: FFT circuitry to generate frequency domain representations of a symbol received over orthogonal frequency division multiplexed subcarriers of a plurality of spatial channels; and subcarrier demodulators to demodulate the frequency domain representations for each subcarrier in accordance with spatial-frequency subcarrier modulation assignments, wherein radio-frequency signals of the spatially channels are received through a single antenna, and wherein the receiver further comprises a beamformer to separate signals of the spatial channels.

-Regarding independent claim 19, none of prior art of record teaches or suggests a method comprising: parsing a block of bits representing an orthogonal frequency division multiplexed symbol into groups having a variable number of coded bits; and individually modulating the groups of bits on orthogonal frequency division multiplexed subcarriers in accordance with spatial-frequency subcarrier modulation assignments to generate symbol-modulated subcarriers for subsequent RF transmission over a plurality of spatial channels, wherein the method is performed by a transmitting station, wherein the spatial-frequency subcarrier modulation assignments are provided by a receiver to the transmitting station to transmit the symbol, and wherein the receiver comprises a subcarrier modulation assignment generator to determine the spatial-frequency subcarrier modulation assignments based on channel characteristics of the spatial channels prior to transmission to the transmitting station.

-Regarding independent claim 22, none of prior art of record teaches or suggests a method performed by a receiving station to receive an orthogonal frequency division multiplexed symbol, the method comprising: generating frequency domain representations of the symbol received over orthogonal frequency division multiplexed subcarriers over a plurality of spatial channels; and demodulating the frequency domain representations for the subcarriers separately for each of the antennas in accordance with spatial-frequency subcarrier modulation assignments, wherein the spatial-frequency subcarrier modulation assignments are provided by the receiving station to a transmitting station to transmit the symbol, and wherein the receiving station comprises a subcarrier modulation assignment generator, and wherein the method further comprises the subcarrier modulation assignment generator determining the spatial-frequency subcarrier modulation assignments based on channel characteristics of the spatial channels prior to transmission to the transmitting station.

-Regarding independent claim 25, none of prior art of record teaches or suggests a system comprising: a plurality of substantially omnidirectional spatially-diverse transmit antennas; and a transmitter, wherein the transmitter comprises: a parser to parse a block of bits representing a transmit orthogonal frequency division multiplexed symbol into groups; and subcarrier modulators to individually modulate the groups of bits on orthogonal frequency division multiplexed subcarriers in accordance with spatial-frequency subcarrier modulation assignments to generate symbol-modulated subcarriers for subsequent RF transmission by the spatially diverse transmit antenna, wherein the spatial-frequency subcarrier modulation assignments are provided by a receiving station to the transmitter to transmit the orthogonal frequency division multiplexed symbol, and wherein the receiving station comprises a subcarrier modulation



Art Unit: 2611

assignment generator to determine the spatial-frequency subcarrier modulation assignments based on channel characteristics of the spatial channels prior to transmission to the transmitter.

-Regarding independent claim 28, none of prior art of record teaches or suggests a computer-readable medium that stores instructions, for execution by one or more processors to perform operations comprising: parsing a block of bits representing an orthogonal frequency division multiplexed symbol into groups having a variable number of coded bits; and individually modulating the groups of bits on orthogonal frequency division multiplexed subcarriers in accordance with spatial-frequency subcarrier modulation assignments to generate symbol-modulated subcarriers for subsequent RF transmission over a plurality of spatial channels, wherein the spatial-frequency subcarrier modulation assignments are provided by a receiver to the transmitter to transmit the symbol, and wherein the receiver comprises a subcarrier modulation assignment generator to determine the spatial-frequency subcarrier modulation assignments based on channel characteristics of the spatial channels prior to transmission to the transmitter.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phuong Phu whose telephone number is 571-272-3009. The examiner can normally be reached on M-F (8:00 AM - 4:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chieh Fan can be reached on 571-272-3042. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Phuong Phu  
Primary Examiner  
Art Unit 2611

/Phuong Phu/  
Primary Examiner, Art Unit 2611  
02/22/08